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Elimination of Acoustical Noise for STM Examination of Pentacene Crystallization on Si (001)

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Abstract

Organic electronics are used in traditional solar cells and also in flexible electronics. Unfortunately, the conductivities of organic semiconductors are significantly lower than their inorganic counterparts. This project examines crystallization by directed self-assembly of the organic molecules via a surface reconstruction as a method to increase conductivity. The crystallization is characterized by Scanning Tunneling Microscopy (STM). In order to achieve optimal STM images, this work examined: (1) noise isolation, (2) etching sharp STM tips and (3) achieving reconstructed Si surface. The STM is housed in a glovebox to keep the surface reconstructions and organic molecules from degrading. However, acoustical noise of the glovebox circulation pump makes achieving atomic resolution impossible. Introducing a foam-lined acoustical shell around the microscope significantly reduced acoustic noise and atomic resolution is achieved. We also determined optimal PtIr tip etching procedures, demonstrating that an alternating current of 40V in a 1M $CaCl_2$ solution results in a tip with an ~ 13µm radius of curvature, comparable to other PtIr tips found in literature. Finally, we demonstrated a Si(001) surface with 20nm terrace widths and two atomic height steps achieved by cleaving inside the N_2 environment.